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A Space-Based Near-Earth Object Survey Telescope in Support of Human Exploration, Solar System Science, and Planetary Defense

Abstract text

Introduction: Human exploration of near-Earth objects (NEOs) beginning in 2025 is one of the stated objectives of U.S. National Space Policy. Piloted missions to these bodies would further development of deep space mission systems and technologies, obtain better understanding of the origin and evolution of our Solar System, and support research for asteroid deflection and hazard mitigation strategies. As such, mission concepts have received much interest from the exploration, science, and planetary defense communities. One particular system that has been suggested by all three of these communities is a space-based NEO survey telescope. Such an asset is crucial for enabling affordable human missions to NEOs circa 2025 and learning about the primordial population of objects that could present a hazard to the Earth in the future.

NEO mission targets: Human accessibility of known objects larger than 30 m requires exposing astronauts to long duration missions and entails development of many advanced technologies and capabilities. Even if these capabilities are assumed, consideration of NEOs within the current database available for human exploration constrains program flexibility and increases budgetary risk. However, there is excellent evidence to suggest that the current number of known NEOs is only a small fraction of the total population. This evidence motivates discovery of additional mission targets among the NEO population to aid in the development of a robust and affordable exploration strategy. Improved knowledge of the NEO population is not only scientifically valuable, but is crucial for planetary defense since many of the accessible NEOs discovered would be potentially hazardous objects. Affordable mission scenarios involve NEOs that can be visited with the minimum practicable mass launched to low Earth orbit, short mission durations, and reasonable Earth re-entry speeds. The most suitable targets for human missions are NEOs in Earth-like orbits with long synodic periods, but these mission candidates are often not observable from Earth via ground-based telescopes until the timeframe of their most favorable human mission opportunities, and thus preclude appropriate time for mission development. These objects spend much of their orbital periods in day-time sky viewing geometries that are not conducive to their discovery from ground-based systems. However, this same phasing that places these objects in the daytime sky and makes them difficult to observe, also enables round-trip missions to these targets with minimal propulsion and duration requirements.

NEO Survey Telescope: A space-based NEO survey telescope optimized for human mission NEO target selection can efficiently find these targets in a timely, affordable manner. Such a system could be ready to launch within four to five years of project commitment and find most affordable NEO targets within two years of launch. A space-based telescope is not only able to discover new objects, but also follow up (track) and characterize objects of interest for human space flight consideration. Four separate system options have been analyzed with costs less than $500 million and capabilities to find several tens of highly accessible targets suitable for human missions within the 2025-2030 timeframe.

Conclusion: Deploying a space-based NEO survey telescope is a logical and prudent first step for enabling human exploration, understanding our Solar System, and developing planetary defense strategies.

TOPICS

04 4 Mission Planning & Technologies

PRESENTATION PREFERENCE

Oral

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